



1 ~ Version of Dec., 2004

2 ~ USSN 09/895,190

3 ~ Patent Application Of

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7 ~ **VOTING DEVICE WITH ENHANCED FEEDBACK**

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9 ~ **Drawings, specifications, claims**

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Background of the Invention

2 1. Field of the Invention:

3 This invention relates to devices for the manual registering of data on
4 machine processable record cards. More particularly it relates to punch-card
5 voting devices.

6 2. Prior art:

7 The principal prior art resides in the basic patents concerning the
8 "Votomatic" voting device, relative to which the invention discloses
9 improvements intended to increase the accuracy of that voting system. The
10 basic patents on the Votomatic are U.S. Patents Nos. 3,201,038 and 3,240,409.
11 A U.S. patent referred to in the latter is No. 3,007,620.

1. VOTING DEVICE WITH ENHANCED FEEDBACK

2. Summary of the Invention

3. All data registering devices, including voting machines, are subject to
4. error, either from human lapses or mechanical malfunction. The object of the
5. present invention is to disclose a device that incorporates features that
6. immediately alert the user to the fact that an error has occurred, before it
7. is too late or too inconvenient for the user to correct it. In voting devices
8. that operate on a machine-processable record card, such as the Votomatic and
9. the Poll Star, votes are counted photo-electrically by shining a light
10. through holes punched in the ballot card. According to the present invention,
11. the greatest certainty regarding what punch-outs represent a valid vote can
12. be obtained only if the same principle is employed to inform the voter as to
13. whether his punch-out is or is not in the intended position and is a complete
14. punch-out. To provide the voter with this verification, backlighting is
15. introduced that directs a beam of light upward through each punch-out toward
16. the voter's eye. To achieve the optimum results, which demand that the
17. frequency of faulty ballots be less than about one percent, the special
18. backlighting features employed are combined with mechanical improvements that
19. minimize defective punch-outs.

20. Backlighting had previously been considered and rejected because it was
21. in conflict with the disposal of the chads. As more and more chads were
22. accumulated underneath the punching surface, they would blanket the light
23. source, reducing or eventually eliminating the illumination and possibly even
24. creating a fire hazard if the light was hot enough. The solution to this
25. problem, which is a main feature of the invention, was to divide the
26. illumination into two parts, one well to the right of the region where the
27. punched out chads fall vertically by gravity, and one well to the left of the
28. region. The two light sources are directed to throw their light at opposite
29. angles toward the underside of the punch card, and this combined effect is a

1 bright vertical beam that tells the voter he/she has (or has not) made a
2 clear punch-out directly adjacent to the right (or wrong) candidate's name.
3 Obtaining this feedback information enables the voter to make immediate
4 correction on his/her original ballot or, for more serious errors, to obtain
5 a fresh ballot card from the precinct attendant. Every form of errant card
6 punch can be quickly identified with this punch-out backlighting. The only
7 person who can make this correction without a breach of ballot secrecy is the
8 voter, and he/she has the full opportunity to make the necessary repair,
9- regardless of whether it is a "dimpled" chad, a "hanging" chad, undervoting,
10 overvoting, or a misplaced vote. Even the notorious "butterfly ballot" which
11 has been shown to confuse and disqualify thousands of voters would not be a
12 problem.

13 When the above-described voter-activated backlighting system for the
14 exposure and correction of ballot errors is combined with some very
15 advantageous improvements in mechanical features, punch-card voting should
16 become more reliable and accurate than any electronic voting system currently
17 available, including optical scanning and touch-screen, as well as costing
18 only a fraction as much to install and operate. Hopefully the improvements
19 disclosed will reduce the observed undervoting or defective voting on punch-
20 card voting devices from its present 1 to 4% to perhaps as low as 1/3 to
21 1/4%. This level of accuracy is better than that of any competing device and
22- should make a manual recount seldom if ever needed. It is quite conceivable
23 that the improvements described herein can achieve what should be the goal of
24 all voting machines: zero disenfranchisement.

25

26 Brief Description of the Drawings

27 FIG. 1 is a sectional view of a voting device embodying the invention.
28 It is analogous to Fig. 2 of U.S. Patent No. 3,240,409, which shows in Fig. 1
29 the position and direction of sight of the sectional cut. The view indicates

1 how a Votomatic could be modified to provide backlighting that illuminates
2 the underside of the punch card.

3 FIG. 2 is a broken-out plan view indicating one method of introducing a
4 limit switch that energizes the lighting circuit when the punch card is
5 properly inserted.

6 FIG. 3 is a wiring diagram for the embodiment that uses a single
7 electric light bulb.

8 FIG. 4 is a wiring diagram for the embodiment that specifies two
9 electrical light bulbs in parallel.

10 FIG. 5 is an enlarged diagram showing how the stylus may bind up in the
11 inner template hole.

12 FIG. 6 is an enlarged diagram showing a modification to the stylus
13 probe that prevents it from binding in the inner template apertures.

14

15 Description of the Preferred Embodiments

16 Because the invention consists of a set of improvements to the punch-
17 card devices covered by the above-listed prior art patents, the descriptions
18 below will concentrate insofar as possible on the new features introduced,
19 showing only as much of the prior art structures as is needed to support the
20 applicant's claims. A full explanation of how the Votomatic voting device
21 operates is provided in U.S. Patent No. 3,240,409, so it will not be
22 reiterated in this specification. The fact that assigned part numbers are the
23 same as those assigned in that patent should not be construed to imply that
24 the disclosed improvements are applicable only to the Votomatic. They are
25 equally applicable to most other punch-card voting devices as well.

26 In detail and referring to the drawings, FIG. 1 is analogous to Fig. 2
27 in U.S. Patent No. 3,240,409. Comparing the two figures, it will be seen that
28 the housing 1 has been made much deeper. This is to provide space for at
29 least one electric lamp but preferably two light sources, consisting of an

1 elongated light bulb 201 to the left of the punching die T-strips 13, and a
2 mirror 202 to the right of those strips. Mirror 202 and the socket 212 for
3 bulb 201 are supported on brackets 213 and 214 fixed to the bottom part of
4 housing 1. Bulb 201 shows here as a circle, since it is a sectional view. A
5 plan view of it would show that its diameter is at most a third of its
6 length, and preferably a fifth or less. The lengthwise dimension of bulb 201,
7 which ideally is similar to the length of the columns of preperforated areas
8 of the punch card, is oriented parallel to the long direction of the base 2,
9 and the same is true of mirror 202. A cylindrical or parabolic reflector 215
10 may be used to direct the light from bulb 201 toward the mirror 202 and the
11 underside of T-strips 13.

12 Both bulb 201 and mirror 202 are mounted below the plane occupied by
13 punch card 5 when that card has been inserted into the device. Mirror 202 is
14 tilted at an angle and has a width such that beams of light from bulb 201 are
15 reflected directly from the lower edge of mirror 202 to the left-most die
16 strip 13, and from the upper edge of mirror 202 to the right-most die strip
17 13. This arrangement ensures that the left side of all the T-strips 13 is
18 illuminated by bulb 201 and the right side by mirror 202, so that when any
19 aperture is made in punch card 5, the combined illumination will send a
20 strong beam of light upward to the eye of the voter. (For "right" read "left"
21 and vice versa if bulb 201 is to the right and mirror 202 to the left of die
22 strips 13.)

23 Several other characteristics of FIG. 1 should be noted. The T-strips
24 have the same shape as the corresponding T-strips 13 in U.S. Patent No.
25 3,240,409, but they are made of a different material. Instead of the opaque
26 black rubber T-strips 13 used in the Votomatic and other prior art punch card
27 devices, the T-strips 13 shown in FIG. 1 are made of a resilient elastomer
28 that is pervious to light (transparent or translucent), such as latex or
29 clear urethane rubber. In addition, the supporting ribs 10 and the lower part

1 of frame 30, which in the Votomatic are molded of opaque plastic, are in the
2 present invention molded of a transplastic such as clear acrylic ("Lucite")
3 or clear polystyrene. The combination of the previous-to-light T-strips 13
4 and the transparent supporting ribs 10, which are an integral part of base 2,
5 ensures that the maximum amount of light will reach the underside of the
6 punch card 5. This gives to the voter "instant verification" that he/she has
7 produced a clear punch-out.

8 It will be evident, from comparing the structure disclosed in FIG. 1 to
9 that of Fig. 2 of the Votomatic patent, that the depth of the sides of base 2
10 has been increased by introducing a transparent protective sleeve 208. This
11 is to ensure that the light sources (bulb 201 and mirror 202) are protected
12 from the chads 62 that have been punched out of card 5. Sleeve 208 is
13 rectangular in a plan view and has a projected area that is the same as card
14 5. Its bottom end opens into a removable plastic collection box 209 that
15 catches the falling chads 62.

16 In general, all of the desirable features of the Votomatic may be
17 retained in voting devices having the improvements disclosed in this
18 specification. This includes (a) making the housing in two parts, a top part
19 and a bottom part, as shown in FIG. 1 and Fig. 2 of U.S. Patent No. 3,240,409
20 and (b) utilizing two templates, an outer template 28 having apertures 61
21 only at positions adjacent to ballot choices printed on the spaced-apart
22 leaves 45, and an inner template 18 having apertures 63 only at positions
23 that are in register with preperforated areas 62 on ballot card 5 when it is
24 inserted into the device far enough to bear against a flange 22 cemented to
25 the lower end of said inner template 18 (see Fig. 9 of U.S. Patent No.
26 3,240,409). As explained in the specification of said patent, when said
27 ballot card 5 is fully inserted, said inner template 18 is shifted to a
28 position of register of the apertures 63, 61 of said inner and outer

1 templates 18, 28 respectively, against the urging of a light spring 25
2 bearing against said flange 22 (per said Fig. 9).

3 Although the Votomatic is the best of all prior punch-card voting
4 devices, it shares with these prior art devices one important shortcoming
5 that is responsible for about half the 1% or so of defective ballots commonly
6 cast on that machine. A failure of the voter to insert the ballot card 5 far
7 enough into the device to bring the template apertures 61, 63 into register
8 causes the punching stylus 64 to strike the outer template 18 between
9 adjacent apertures 63 so that it is prevented from reaching the ballot card
10 5. To remedy this particular shortcoming, the present invention proposes to
11 put the switch that turns on the backlighting at a position such that the
12 energizing of light sources 201 and 202 occurs only if the inner template 18
13 is at the point where apertures 61 and 63 are both in register with
14 preperforated areas 62, that is to say, when the ballot card 5 is fully
15 inserted. Since the voter is instructed not to vote until the backlighting is
16 on, this serves as a dramatic reminder that the ballot card must be fully
17 inserted.

18 One way to switch on the backlighting is shown in FIG. 2. This is a
19 partial plan view of the bottom end of the inner template 18, made visible by
20 a break-out of part of frame 30. Flange 22 projects downward from the lower
21 end of the inner template 18 and carries a light metal leaf spring 203 in
22 place of the coil spring 25 shown in Fig. 9 of U.S. Patent No. 3,240,409. At
23 or adjacent to the central portion of leaf spring 203 or any convenient point
24 on flange 22 or the bottom edge of the inner template 18, there is a limit
25 switch 205 that is positioned to close at the exact point when the
26 preperforated areas 62 of card 5 and apertures 61 and 63 are all in register.
27 Limit switch 205 is mounted on an L-shaped bracket 210 that is in turn
28 mounted on the lower portion of housing 1. One lead of limit switch 205 is

1 connected to bulb 201 and the other to the main power supply, as shown in
2 FIGS. 3 and 4.

3 It will be seen from FIG. 3 that the power circuit for bulb 201 is a
4 very simple one, consisting only of the bulb itself and limit switch 205 in
5 series. The bottom part of housing 1 may be either metal or plastic, but if
6 it is metal it should be connected to the ground wire of the power supply
7 cord. Although it is possible to use a second bulb in parallel with bulb 201
8 (FIG. 4), this is less desirable than using one bulb and a mirror 202, as
9 shown in FIG. 1, on the basis of first cost, heat generation, and amperage
10 load imposed on limit switch 205. Mirror 202 may of course be omitted, but
11 this would cause the right hand columns of punch-outs to have less
12 illumination than the left-hand columns.

13 FIG. 5 is a schematic drawing that illustrates the second main
14 shortcoming of the Votomatic, which is just as serious as failing to insert
15 the ballot card 5 fully. In FIG. 5, it will be seen that the stylus 64 is not
16 held vertical to the face of the inner template 18, so that the stylus probe
17 65 is subject to what may be called "the dresser drawer effect." Because the
18 apertures 63 in the inner template 18 are partly cylindrical, the sharp edge
19 of the probe 65 can dig into the side wall of the aperture 63, and bind the
20 stylus 64 against further inward movement. If there is substantial tipping of
21 the stylus 64, the digging in will occur high up in aperture 63 so no mark
22 will be made on the ballot card 5, and no vote will have been cast. If the
23 stylus 64 tipping is less extreme, the digging in will occur much closer to
24 the bottom of the aperture 63, so that only the needle-like tip 71 of the
25 stylus 66 will reach the card 5, to make a "dimple" on the preperforated area
26 62 but no dislodgement of this area will occur, and the mechanical card-
27 reader will not record a vote. This opens the door to controversies as to
28 what should count as a vote and what should not.

1 To reduce the frequency of such problems, a small change may be made
2 to the stylus probe 65, as indicated in FIG. 6. The sharp corner of the
3 stylus probe 65 is rounded sufficiently to prevent the "dresser drawer"
4 effect. The particular amount of rounding depends on the clearance provided
5 between the diameter of the cylindrical portion of the aperture 63 in
6 template 18 and the diameter of the stylus probe 65. It is also important
7 that the rounded portions have as smooth a finish as the balance of probe 65,
8 so that both can be completely free of machining ridges or grooves.

9 As is shown in FIG. 5 the Votomatic stylus 64 has a needle-like tip 71
10 protruding from the end of the probe 65. The function of this small
11 protrusion is to spear the preperforated area 62 of card 5 so that it cannot
12 slide laterally during the punching action and hang up on one end or one
13 side, producing what is called a "hanging chad" instead of a clean punch-out.
14 There is not so much question that a hanging chad counts as a vote in a
15 manual recount, but if such a chad happens to get folded back to reoccupy its
16 original aperture in the main body of card 5, no light may be transmitted
17 through the punch-out so no vote will be recorded. For this reason it is
18 desirable to strip away any hanging chads present on the completed ballot.
19 This can and should be done by the voter, with or without the aid of the
20 backlighting. It is important to note that a stylus 64 on which the needle-
21 like tip 71 has been broken or worn off will produce many more hanging chads
22 than one on which the spear-like tip 71 is intact.

23 In summary, it should be noted that the foregoing disclosures all have
24 the same objective, namely the reduction of ballot errors currently being
25 produced by the best presently available voting device, the Votomatic, from
26 its average error rate of about 1% to 0.5% or less. A realistic goal may be
27 as small as 0.2 or 0.3%. The shortcomings of the Votomatic (sensitivity to
28 insufficient insertion of the ballot card 5 and tilting of the stylus 64)
29 have both been addressed herein by three innovations, and it is the hope of

1 the applicant that this "fail-safe" approach will achieve the desired
2 results, of largely eliminating voting errors.

3 Both the above-noted shortcomings are addressed by (1) more visible
4 instructions and (2), the disclosed system of backlighting, which affords the
5 voter a unique "instant verification" of a clean punch-out. The third
6 innovation is different for each of the two above-noted shortcomings.
7 Insufficient card insertion is addressed by having the backlighting turned on
8 by full insertion of the ballot card 5, and excessive tilting of the stylus
9 64 is offset by rounding the sharp corner of the stylus probe 65.

10 The following observations are believed to be relevant to the claims:
11 (a) All punch-card voting devices are designed for a particular ballot card
12 5, because the horizontal spacing of the parallel columns of perforated areas
13 62 must be the same for apertures 61 and 63, adjacent leaf 45 axes, and
14 adjacent die T-strip 13 slits 14 and ribs 10; similarly, the vertical spacing
15 of the parallel rows of the preperforated areas 62 must match the vertical
16 spacing of apertures 61 and 63 and choices exhibited on the ballot leaves 45.
17 Most punch card voting devices are designed for the same generally available
18 ballot card 5, which has 12 columns and 26 rows of preperforated areas 62.
19 Accordingly, the card 5 is not part of the claimed structure. (b) Preferred
20 lamps include a long and narrow incandescent bulb (type T10) or an even
21 longer and narrower fluorescent bulb (e.g., F9BX). The latter runs cooler and
22 imposes only a fourth as much amperage on the limit switch 205. A bank of
23 LEDs can also be used. (c) The description "pervious to light" includes both
24 transparent and translucent. (d) If it is desired to reduce the number of
25 hanging chads, the preperforated areas 62 may be made circular, in which case
26 the slits in the punching die should be two directional, as for example a +
27 shape. (e) In keeping with industry usage, a preperforated area 62 is called
28 a "chad" once it is fully or partially detached from the body of the ballot
29 card 5. (f) For the purposes of the claims, a stylus is a light form of

1 punch, appropriate for a punch-out that has been preperforated. (g) Any light
2 source used should be offset from the region beneath the die, so that no
3 chads will blanket it. (h) The term "lamp" or "electric light bulb" includes
4 all types of bulb, whether incandescent, fluorescent, LED bank, or any other
5 form of electrically-driven illumination. (i) Instead of the enclosed limit
6 switch 205 shown in FIG. 2, two contacts on leaf spring 302 may be used. (j)
7 The preferred feature for holding the ballot card 5 in place is the same one
8 used by the Votomatic, which is a pair of red colored pins. (l) Although the
9 device disclosed herein is called a "voting device," it may also be used for
10 exams, surveys, etc. (m) If desired, a blinker may be introduced into the
11 lighting circuit. (n) The removable catch basket 209 provided to catch the
12 falling chads should be either transparent or low enough not to interfere
13 with light beams emitted by bulb 201 and directed toward the T-strips or
14 mirror 202. (o) Mechanical devices could be introduced to overcome the
15 shortcomings of the Votomatic, but they would increase the cost of the
16 disclosed device and increase its complexity. The latter is always a problem
17 because complexity tends to produce errors. Examples of such mechanical means
18 include a door that is closed to force a complete insertion of the ballot
19 card 5 as shown in Fig. 11 of U.S. Patent No. 3,240,409. Another such device
20 that could be introduced to keep the stylus 64 perpendicular to the ballot
21 card would be a square-section telescoping arm pivotally mounted at one
22 corner of the housing 1 and holding at its free end a vertically slidable
23 stylus. It appears likely that the complexity of such arrangements would
24 produce more errors than will occur with the above described tip-rounded
25 stylus fastened to a bead chain. (p) Another mechanical device that could be
26 introduced is a sharpened sheet steel scraper mounted on the bottom of the
27 ballot slot 4. The purpose of this would be to scrape off the back side of
28 the ballot any hanging chad as the ballot is withdrawn from its slot. While
29 it is desirable to get rid of all hanging chads, this is not the way to do

1 it, as it deviates from the basic concept of the present invention, which is
2 to alert the voter to any improper punch-out so he/she can take steps to make
3 the necessary repair. Since the scraper would operate on the ballot after the
4 voter has finished, the "instant verification" would be circumvented and any
5 unexpected error produced by the scraper would go uncorrected. It is much
6 better to have "hanging chads," on the rare occasions when they do occur,
7 discovered and corrected by the voter. (q) The term "light source" means an
8 electric lamp or at least one mirror or other reflective surface. (r) If a
9 sole lamp or light bulb is positioned above the plane of the card 5, there
10 must be at least one mirror or other image-reflecting surface below that
11 plane. (s) If bulb 201 is an incandescent light, apertures should be provided
12 in the top and bottom of housing 1 to increase the convection of air for
13 cooling. (t) On the same side of housing 1 that houses lamp 201, a "ready-to-
14 vote" signal light (preferably green) may be mounted, to tell the voter that
15 the backlighting is operative. This signal light could be illuminated by
16 diverting a small portion of the light produced by bulb 201 by a small
17 mirror. (u) Since the "light source" of the claims is on for only about 5
18 hours per year, the cost of power per year is only a few mils per year. It is
19 therefore advantageous to minimize the error rate by maximizing the
20 luminosity of the light source (wattage), but also by optimizing the
21 ventilation and by strategic use of reflective interior surfaces. Although
22 the use of light sources as small as three watts will give passable error
23 rates for many jurisdictions, the inventor recommends that wattages eight or
24 ten times as great be employed. (v) Another means for minimizing the error
25 rate, in addition to the maximization of the intensity of the backlighting,
26 is to maximize the number of hanging and dimpled chads that are corrected by
27 the user repunching one or more times. The instructions for the voter to do
28 this may be summarized by a sign mounted in the voting booth showing how to
29 use the stylus to remove dimpled chads and chads hanging by 2- or 3-corner